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ABSTRACT

An annual study of physical science graduate students' background characteristics and degree recipients' employment outcomes was conducted for 1995. The total pool of 1994-95 physics graduate students was 13,285 with non-U.S. citizens making up 43 percent. Among U.S. citizens, 18 percent entered graduate school 2 or more years after earning a Bachelor's degree. Over half of the non-U.S. citizens entered graduate school in the United States 2 or more years after earning their Bachelor's degree. The number of years taken to obtain a Ph.D. has risen with over 20 percent taking 8 years or more and fewer than 5 percent earning their degrees in 4 years. The number of women has continued to increase: from 8 percent in 1975 to 16 percent in 1995. Tables provide data on employment of physics graduate students including country of origin, racial/ethnic background of graduate students with U.S. citizenship, financial support, academic background, subfield of study, time taken between Bachelor's degree and physics graduate study, and time taken between Bachelor's degree and physics graduate study, postdoctoral positions, annual salaries, and overall Master's degree recipient characteristics. (JLS)

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AIP REPORT

by Elizabeth Dodge
Patrick J. Mulvey

AIP Pub No. R-207.28

September 1996

ED 399 915

1995 GRADUATE STUDENT REPORT

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September 1996

1995 GRADUATE STUDENT REPORT

HIGHLIGHTS

- The total pool of 1994-95 physics graduate students was 13,285.
- Non-US citizens made up 43% of the 1994-95 physics graduate students, a level that has remained stable since 1990. **(Table 2)**
- The percentage of women among physics graduate students continued to increase, in keeping with a trend begun more than twenty years ago. **(Figure 1)**
- While most physics graduate students decided to pursue graduate study during their undergraduate years, nearly one-quarter made that decision after earning their bachelor's degree. **(Figure 3)**
- Among US citizens, 18% entered graduate school two or more years after earning a bachelor's degree. Over half of the non-US citizens entered graduate school in the US two or more years after earning their bachelor's degree. **(Table 8)**
- The majority of physics graduate students were supported throughout their education. While many of the first-year students were supported as teaching assistants, the dominant source of support shifted to research assistantships by the third year of study. **(Figure 2)**
- The time to PhD has been gradually increasing for nearly thirty years. Fewer than 5% of the class of 1995 earned their PhDs in four years. By contrast, over 20% of the class took eight or more years of full-time equivalent study. **(Figure 4)**
- The median length of time for an initial physics postdoctoral appointment in the US was two years. **(Figure 7)**
- The median annual salary for PhDs accepting full-time employment in the industrial sector increased from the previous year, as did the median annual salary for PhDs with university, FFR&DC and government postdoctoral appointments. **(Table 13)**

Member Societies: The American Physical Society • Optical Society of America • Acoustical Society of America • The Society of Rheology • American Association of Physics Teachers
American Crystallographic Association • American Astronomical Society • American Association of Physicists in Medicine • American Vacuum Society • American Geophysical Union

INTRODUCTION

The Education and Employment Statistics Division of the American Institute of Physics (AIP) has reported on the characteristics of physics graduate students and degree recipients for the past three decades. Important trends have developed during this period, including a rise in the number of years taken by physics students to obtain a PhD and the increased percentage of women enrolled in physics graduate programs. **Table 1** shows the distribution of the respondents to the 1994-95 Graduate Student Survey (GSS), which is sent to all graduate students at US physics departments. The right column, showing the total number of physics graduate students (13,285), is taken from AIP's annual Enrollments and Degrees Report, which summarizes data reported by all US graduate physics departments.

Table 1. GSS respondents and the physics graduate student population, 1994-95.

	GSS response rate %	Total physics graduate students *
First year of study	43	2,604
2+ years of study	52	8,235
Received master's (excluding enroute degrees)	31	985
Received PhD	42	1,461
Total	47	13,285

*Data from Enrollments and Degrees Report

PHYSICS GRADUATE STUDENTS

The GSS respondents represented close to half of the total physics graduate student population. **Table 2** provides background characteristics for these respondents. The citizenship breakout maps closely to the population data reported in the Enrollments and Degrees Report, with physics departments reporting 57% US citizen graduate students compared to 61% among GSS respondents. Among the foreign citizens with permanent residence status (15%), more than one-third were from China. The number of Chinese students with permanent resident status has increased in recent years due to the Chinese Student Protection Act, which enabled Chinese students to apply for permanent residence status if they were in the US during 1989. Prior to the Act, Chinese respondents made up less than 1% of the permanent residents, and the percent is expected to return to this level in the coming years as the effect of the Act wanes.

Table 2. Characteristics of physics graduate student respondents, 1994-95.

	%	
Sex		
Male	84	
Female	16	
Citizenship		
US *	57	
Non-US *:	43	
Permanent Resident		15
Temporary Visa		85

*Data from Enrollments & Degrees Report

There has been a gradual but steady rise in the percentage of women in physics graduate study over the past twenty years. **Figure 1** summarizes that rise by plotting three years of data which depict the continuing rise. Throughout most of this period, women with foreign citizenship represented a higher percentage among all foreign citizens than their US women counterparts among US citizens. By the mid-1990s, however, US women had caught up to foreign women, with both representing 16% of their respective groups. The increased percentage of women in physics graduate study has likely been influenced by such issues as recruiting efforts made by physics departments and the increased focus on science for girls in both primary and secondary schools.

Figure 1. Percentage of women among GSS respondents, 1975-1995.

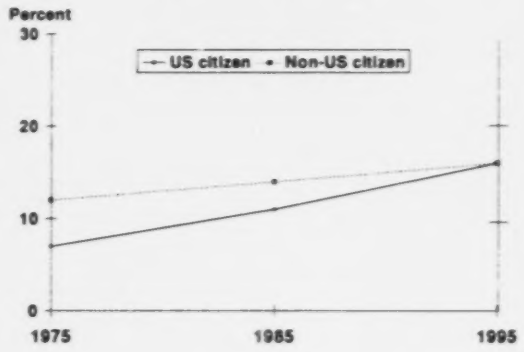


Table 3 and **Table 4** provide information on the geographic origins of non-US graduate respondents and the racial/ethnic background of US respondents. The distribution of country of origin in **Table 3** has remained stable over the past ten years. **Table 4** shows that, as in previous years, African Americans and Hispanic Americans were underrepresented among responding physics students compared to their distribution within the student-aged population as a whole. Three percent of the US citizens who declined to classify their race were excluded from **Table 4**.

Table 3. Region/country of origin of physics graduate students who were not US citizens, 1994-95.

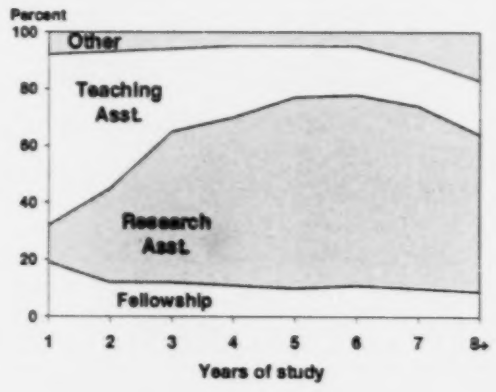
	%
People's Republic of China	28
Former Soviet Bloc	16
Western Europe	14
India	8
South Korea	7
Taiwan	5
Other Asia	7
Middle East	5
South & Central America	4
Canada, Australia	4
Africa	2

Table 4. Racial/ethnic background of physics graduate students with US citizenship, 1994-95.

	%
African-American	2
East Asian	4
Hispanic	3
Asian Indian/S. Asian	1
White	88
Other	2

The vast majority of students are supported throughout their graduate education. **Figure 2** shows the primary type of financial support doctoral students received by the number of years they had been attending a graduate program. Students traditionally start with teaching assistantships and then switch to research assistantships, a trend evident in the figure. The categories labeled Fellowship and Other remained small and relatively independent of the year of graduate study. Personal savings, loans, employment outside the physics department and foreign government aid were collapsed into the group labeled Other.

Figure 2. Financial support for physics graduate students by year of study, 1994-95.



Although a physics bachelor's degree is not a prerequisite for graduate study in physics, **Table 5** shows that over 90% of the respondents majored in the field as undergraduates. The table also shows the type of institution where the students received their bachelor's degree. A school's type is categorized as the highest degree offered by its physics department. Only twenty-one percent of the US respondents who earned their bachelor's at a school with a graduate program in physics (excluding those who attended a bachelor's institution) stayed on for their graduate studies, while 79% transferred elsewhere.

Table 5. Academic background of physics graduate students, 1994-95.

	US citizens %	Non-US citizens %
Major of bachelor's degree		
Physics	90	94
Engineering	4	4
Mathematics	2	1
Other	4	1
Institution type for bachelor's degree		
PhD-granting	63	7
Master's-granting	6	1
Bachelor's-granting	30	3
Foreign institution	1	89

The distribution of subfields has changed little in recent years. Respondents were asked to identify their research field from a listing of 28 physics subfields (or write in their subfield if it was not included in the list). **Table 6** lists the most common subfields that respondents from PhD institutions in their third or later year of study identified as their own. Both Condensed Matter and Particles and Fields continue to exceed other subfields in interest, combining for more than one-third of the respondents' subfield of study.

Table 6. Subfield of study for physics graduate students with 3+ years of study at a PhD institution, 1994-95.

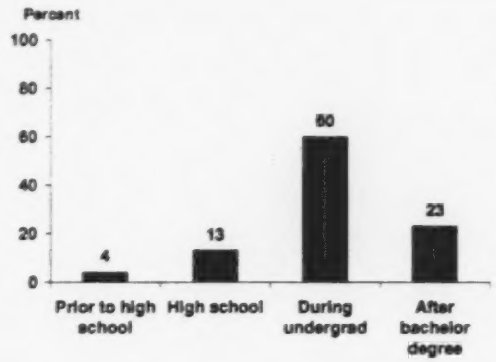
	%
Condensed Matter	23
Particles & Fields	13
Astronomy & Astrophysics	8
Nuclear Physics	7
Atomic & Molecular	7
Optics & Photonics	6
Atmospheric, Space Physics & Cosmic Rays	4
Surface Physics	4
Biophysics	3
Materials Science	3
Plasma & Fusion Physics	3
Applied Physics	3
Relativity & Gravitation	2
All other subfields	14

To provide a sense of the sources of students' interest in physics, two open-ended questions were posed that asked respondents when they decided to attend graduate school in physics and who or what influenced their decision. **Table 7** lists in rank order who or what influenced their decision to attend while **Figure 3** is a timeline showing when students decided on graduate study. A tie ranking is shown in **Table 7** for the sixth rank because of the close frequency in responses. Respondents' gender was not a factor in who influenced their decision and when they decided on physics graduate study.

Table 7. Influences on GSS respondents to study at the graduate level, 1994-95.

	Rank
The subject matter	1
Teacher, advisor, co-worker	2
Desired career path	3
Family, friends, self	4
Employment outlook	5
Undergraduate experience, internship	6
Science program, books, conferences	6
Funding available, fellowship	8

Figure 3. Period when physics graduate students decided to attend physics graduate school, 1994-95.



While the majority of physics students decided to attend graduate school while they were undergraduates, nearly one-quarter made that decision some time after they earned their bachelor's degree. The amount of time physics graduate students took between receipt of a bachelor's degree and matriculation into physics graduate study is illustrated in **Table 8**.

Table 8. Time taken between bachelor's degree & physics graduate study, 1994-95.

	US citizen %	Non-US citizen %
Next academic year	68	35
1 year	14	13
2 - 5 years	12	34
More than 5 years	6	18

PHYSICS PhD RECIPIENTS

Physics department chairs reported that 1461 physics PhDs were conferred during the academic year 1994-95. The Graduate Student Survey attempted to survey all of the physics graduate students and of the respondents, 620 indicated they were receiving a PhD in the 1994-95 academic year. **Table 9** lists characteristics of these PhDs, including their field of undergraduate study and the type of research method they used during graduate study. Experimentalists far outweighed either theoreticians or those focusing on computer simulations, as was also the case in previous years. There was no significant relationship between type of research method and specific subfields of study.

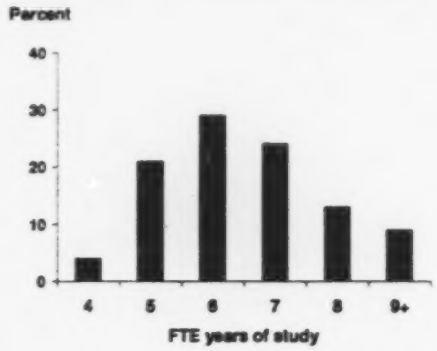
Table 9. PhDs' characteristics, 1994-95.

	%
Citizenship *	
US	52
Non-US	48
Gender *	
Male	88
Female	12
Age	
< 27	2
27-28	21
29-30	27
31-32	22
33-34	13
35+	15
Major of bachelor's degree	
Physics	92
Engineering	3
Other physical sciences	2
Mathematics	2
Other	1
Primary research method used	
Experimental	70
Theoretical	21
Computer Simulation	9

* Data from Enrollments & Degrees Report

Over the past 25 years of collecting GSS data, there has been a gradual increase in the time US citizens took to complete their degree, from a mean of 5.3 academic years in 1969-70 to a mean of 6.5 academic years in 1994-95. **Figure 4** shows the number of full-time equivalent (FTE) years respondents took to complete their graduate education. Responses of nine or more years of study were grouped together, causing a slight underestimate in the computed mean but not diminishing the twenty-five year trend towards increasing time to complete a physics PhD.

Figure 4. Full-time equivalent (FTE) years of study for PhD recipients, US citizens only, 1994-95.



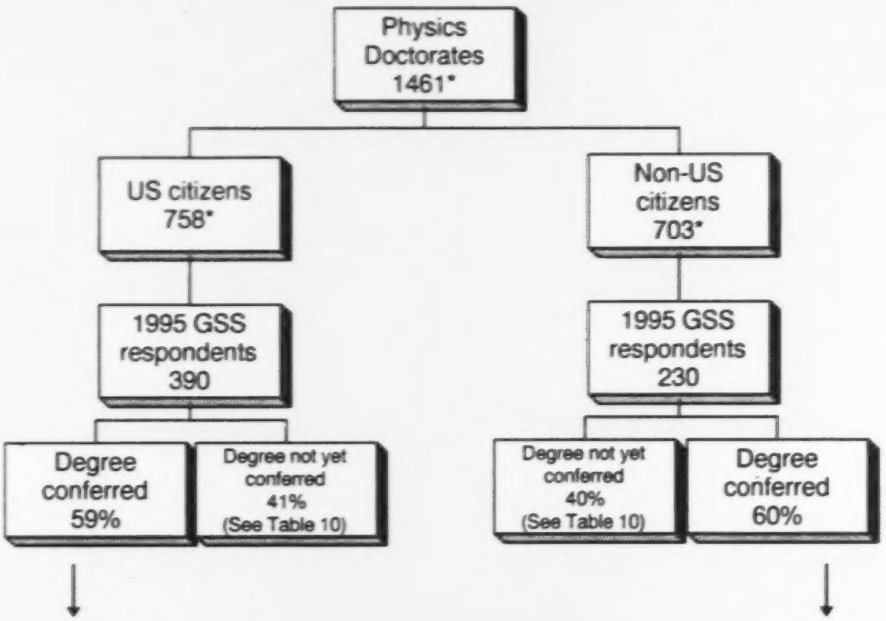
Because of the timing of the survey, some summer graduates had not begun a job search when they filled out their questionnaires. These PhDs were excluded from **Figure 5** (which depicts post-degree status), and are shown instead in **Table 10**, which identifies the post-degree plans of summer PhD recipients only. These latter results should be treated with caution, because such plans may change following exposure to the job market. On the other hand, **Figure 5** shows the post-degree status for the PhD respondents who had received their degrees by the time of survey completion. Thus, **Table 10** and **Figure 5** combine to represent all of the GSS PhD respondents. For both the table and the figure the percentage listed as seeking employment included those that may have received a job offer but have yet to accept the offer.

Table 10. Post-degree plans of PhDs without the degree at the time the survey was conducted, 1994-95.

	US citizen %	Non-US citizen %
Postdoctorate position in the US	32	26
Postdoctorate position abroad	4	8
Permanent employment in the US	14	7
Other temporary position in the US	4	1
Seeking/Will seek employment	45	48
Permanent position abroad	-	4
Other graduate study	1	6

Only PhD respondents who had accepted employment are included in **Figure 6**, regardless of their degree conferred date. For this figure and throughout the remainder of this report, all PhD employment data includes those who had definite post-degree commitments, even if they had yet to receive their degree at the time of survey completion. **Figure 6** reveals a greater proportion of permanently employed respondents (35% US and 25% non-US) than was the case last year (25% US and 16% non-US). Postdoctoral and other temporary positions decreased in percentage from last year. The decrease in the overall percentage of students accepting postdocs should be treated warily. It is possible that this decrease is an indication of saturation among available postdoctoral positions. But an equally viable explanation concerns the timing of the 1994 and 1995 GSS. The 1995 survey was sent out about one month earlier than the previous year's survey. The rise in the proportion of respondents with jobs may result from permanent positions commonly being accepted earlier in the year than postdoctorate positions.

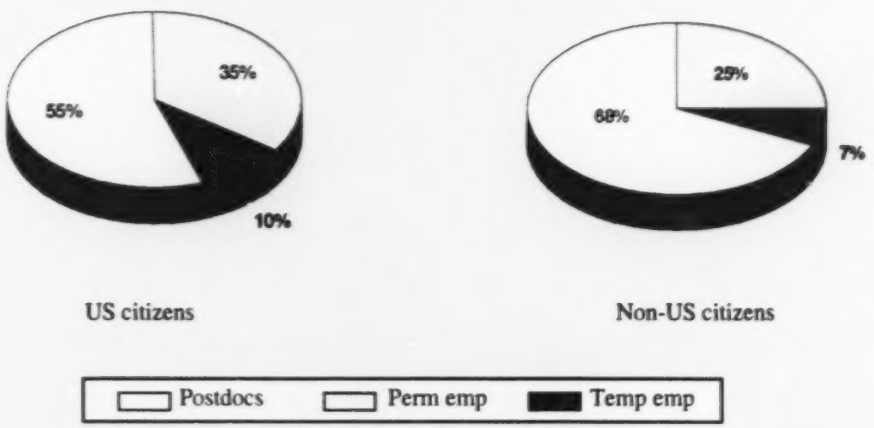
Figure 5. Post-degree status of physics doctorates who had earned their degree by the time of survey completion, 1994-95.


Physics Doctorates 1461*
US citizens 758*
Non-US citizens 703*
1995 GSS respondents 390
1995 GSS respondents 230
Degree conferred 59%
Degree not yet conferred 41% (See Table 10)
Degree not yet conferred 40% (See Table 10)
Degree conferred 60%

39%	Postdoctorate position in the US	44%
4	Postdoctorate position abroad	8
30	Permanent employment in the US	18
8	Other temporary position in the US	6
18	Seeking employment	17
--	Leave the US - perm. employment or unknown status	5
1	Other graduate study	2

* Data from Enrollments and Degrees Report

Figure 6. Type of US employment secured by PhD recipients, 1994-95.



Of the employed PhDs, 59% were committed to a postdoc, 32% accepted a permanent position and the remaining 9% accepted a temporary position other than a postdoctorate. **Table 11** shows the employment sectors for the PhDs in postdocs and permanently employed in the US. The industrial sector employs very few postdocs but it is the leading employer for permanent positions.

Table 11 also shows that for some respondents, the fact that they secured employment does not mean that they abandoned the job search, with 28% of the postdoctorates and 17% of the permanently employed continuing to seek other employment. In addition, not shown in the table is 56% of the other temporarily employed PhDs continuing to seek employment.

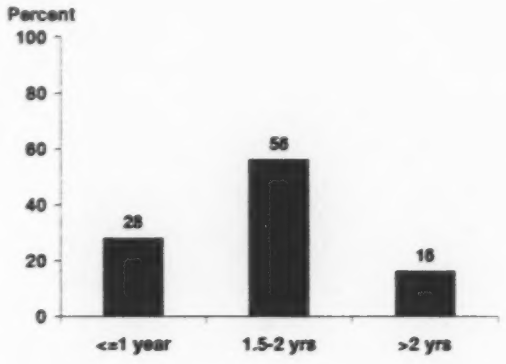
Table 11. Employment sector and job search status for US employed PhDs, 1994-95.

	Postdoctorate position %	Permanent employment %
University	69	10
Industry	2	57
FFR&DC *	21	4
Government civilian	5	6
4-year college	-	8
Non-profit organization	2	3
2-year college	-	5
Military	-	4
Other	1	3
Accepted position and still seeking other employment	28	17

*FFR&DC or federally funded research and development centers are 29 facilities with a significant physics component in their mission such as Brookhaven and Los Alamos.

Over half of the postdoc respondents indicated that their commitment was for two years of employment. **Figure 7** shows the duration of the initial appointment for respondents who accepted postdoctorate positions in the US. For some, this allows further training in their field, while for others it provides time to search for future permanent employment.

Figure 7. Length of time for postdoctoral positions, 1994-95.



A significant number of physicists who earn their PhDs in the US take initial jobs abroad. **Table 12** shows the percentage of the employed US citizens and foreign citizens that were working abroad. Of the US citizens, all were working in postdoctorate positions, compared to 66% of the foreign citizens. The length of an initial postdoctorate position abroad corresponded with the length in the US. Over half of the positions were for two or more years.

Table 12. Percent of employed PhDs working abroad immediately after degree completion, 1994-95.

	%
US citizens	7
Non-US citizens	18

Table 13 shows the median annual salary for PhD respondents employed full-time. Permanent positions in the industrial sector increased from $50,000 last year to $54,000 this year. The number of respondents finding permanent positions in sectors other than industry were too scattered to report reliable salaries. The median annual salary for postdoctorate positions at FFR&DC/government remained the same as last year and university salaries increased by $1,000.

Table 13. Median full-time annual salary for PhD respondents, 1994-95.

	Median Salary $
Permanent Position	
Industry	54,000
Postdoctorate Position	
FFR&DC */Government	36,000
University	31,000

* Federally funded research & development center

PHYSICS MASTER'S RECIPIENTS

According to the Enrollments and Degrees Report, there were 985 professional master's degrees awarded in the 1994-95 academic year. This number does not include students enrolled in doctoral programs who earned their master's degree enroute to a PhD and who are not included in the following analysis on master's recipients. Three hundred 1994-95 GSS respondents identified themselves as master's recipients. **Table 14** lists their characteristics. About twice as many students received their degree from a PhD-granting institution than from a master's-granting institution. The table also shows that twice as many recipients had teaching assistantships as had research assistantships for their primary source of financial support.

Table 14. Physics master's degree recipient characteristics, 1994-95.

	%
Citizenship *	
US	61
Non-US	39
Gender *	
Male	83
Female	17
Age	
< 25	20
25-26	24
27-28	18
29-30	12
31-32	8
33-34	5
35+	13
Major of bachelor's degree	
Physics	87
Engineering	6
Other physical sciences	3
Mathematics	2
Other	2
Type of graduate institution	
PhD-granting	65
Master's-granting	35
Source of support	
Teaching Assistantship	43
Research Assistantship	21
Fellowship	6
Family, savings, loan	9
Non-departmental employment	9
Military	6
Other	6

* Data from Enrollments and Degrees Report

The subfields that master's recipients studied are shown in **Table 15**. Condensed matter continued to attract a lot of interest as was true for the PhD recipients. Optics was more common among master's degree recipients than PhD recipients. The converse was true for particles and fields. The table shows that half of the respondents specialized in the six subfields listed and the other half were broadly distributed across another twenty-two subfields.

Table 15. Subfield of study for physics master's recipients, 1994-95.

	%
Condensed Matter	14
Optics & Photonics	11
Astronomy & Astrophysics	7
Atomic & Molecular	7
Particles & Fields	6
Medical & Health Physics	5
All other subfields	50

Thirty-six percent of the master's respondents indicated that they were going to continue graduate study, either staying in physics but moving to another institution, or else switching to a completely different field. Over half of these students were non-US citizens and were leaving the US to continue their graduate study. **Table 16** shows some of the fields of study respondents listed for future study. Interestingly, about 20% were leaving science/engineering fields altogether. For master's recipients who accepted employment, 85% accepted permanent employment while the remainder were working in temporary positions. Of the permanently employed 49% listed their employer as industry, 14% as military and 8% as university. Considering the small numbers of individuals in each employer category, these percentages should be treated as only rough estimates. The median full-time annual salary for the master's recipients who reported working in industry was $36,500.

Table 16. Subject of study for physics master's recipients continuing graduate study, 1994-95.

	%
Physics	37
Engineering	19
Humanities	12
Computer science	11
Business & Law	6
Astronomy	5
Other physical sciences	5
Other	5

ASTRONOMY STUDENTS

The AIP also surveyed astronomy graduate students with a survey similar to the physics survey. In 1994-95, physics and astronomy department chairs reported 871 astronomy graduate students. A total of 573 astronomy students responded to the survey. **Table 17** presents background characteristics of the responding astronomy students. Astronomy PhDs were more likely to be involved in computer simulation than were physics PhDs. The majority of astronomy students were supported throughout graduate school with ninety-one percent receiving a teaching/research assistantship or fellowship as their primary source of financial support.

Table 17. Astronomy graduate student characteristics, 1994-95.

	%
Subfield of study	
Extragalactic	14
Stellar evolution	14
Active galaxies/Quasars	9
Solar system/Space physics	9
Other	54
Primary research method used	
Experimental	69
Theoretical	14
Computer simulation	17
Type of research instrument	
Ground-based	56
Space-based	8
Both	36

ASTRONOMY PhD RECIPIENTS

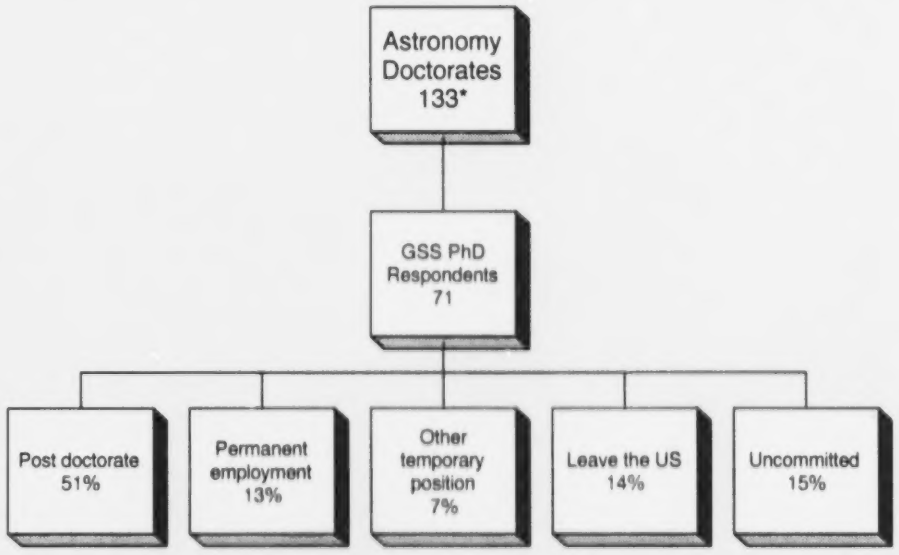
During 1994-95, 133 astronomy PhDs were conferred. **Table 18** and **Figure 8** describe the characteristics and plans of the PhD astronomy respondents for 1994-95. Gender and citizenship data are reported from the Enrollment and Degrees Report. A greater percent of women are in the astronomy graduate population than in the physics graduate population. Conversely, there were proportionately fewer foreign citizens among astronomy PhDs than among physics PhDs. The median age at PhD and the median years of study were similar for astronomy and physics PhDs. The median full-time annual salary reported by respondents in a postdoctorate position was $35,000 while the number of respondents in a permanent position was not sufficient to report a median salary.

Table 18. Astronomy PhD background characteristics, 1994-95.

	%
Citizenship *	
US	71
Non-US	29
Gender *	
Male	77
Female	23
Median age	30
Median years of full-time equivalent graduate study	6

* Data from Enrollments and Degrees Report

Figure 8. Astronomy PhD recipients' post-degree outcomes, 1994-95.



* Data from Enrollments and Degrees Report

EDUCATION AND EMPLOYMENT STATISTICS DIVISION PUBLICATIONS

The Education and Employment Statistics Division collects data on the composition and dynamics of the scientific labor force and the education system. Below is a list of the Division's current publications along with a brief description of each. Unless otherwise indicated, single copies are available free of charge by writing to: American Institute of Physics, Education and Employment Statistics Division, One Physics Ellipse, College Park, MD 20740-3843 or by calling (301) 209-3070. When applicable, all orders must be prepaid. Please make your checks payable to the American Institute of Physics.

Academic Workforce Report
A discussion focusing on faculty openings and candidate availability in selected physics subfields.

**Bachelor's Degree Recipients Report*
A summary of the characteristics and career goals of physics and astronomy bachelor's degree recipients.

**Enrollments and Degrees Report*
An examination of academic enrollments and degrees conferred in physics and astronomy programs nationwide.

**Graduate Student Report*
A summary of the characteristics and initial employment outcomes for physics and astronomy graduate students.

**Initial Employment Report*
A description of the initial employment search and eventual employment of physics and astronomy degree recipients.

National Laboratory Workforce Report
A study of PhD physicists working in Federally-Funded Research and Development Centers.

****Physics in the High Schools II*
An analysis and interpretation of information collected in a nationwide survey of teachers of physics at the secondary level.

***1994 Salaries: Society Membership Survey*
An analysis of the effect of factors such as geographic location, employment sector, gender, years from degree, and degree level on salary levels and salary increases. **$15** for a single copy, **$10** each for multiple copies.

*** 1994: Salaries Summary Report*
A two-page summary which gives overall trends and salaries.

Society Membership Profile: Rich Diversity and Common Concerns
A description of the employment and demographic characteristics of the membership of the 10 AIP member societies.

* Published annually
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